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RESEARCH, AN EDUCATIONAL ASSET¹

It is eminently fitting that the university should pause in the midst of its busy life to do honor to those students who have won distinction by their scholarly achievements. Educators of our day have complained that the "side shows" of our educational system are attracting more attention and receiving more generous support than the main purposes for which the system itself was established. Many a bitter complaint has been registered against the custom of lionizing the athletic hero and ignoring the student who has outstripped his fellows in the intellectual pursuits of the classroom. That such a tendency exists few will deny, but the evil, if such it be, can never be corrected by complaint nor by eulogizing the intellectual giants of the good old days when higher education was the privilege of the select few and the masses of the people were denied the educational advantages of which our modern democratic civilization is so proud. The purposes of Honor's Day and its associations are to recognize excellence in scholarship and to furnish in some tangible fashion a reward for leadership in the intellectual pursuits of college life.

There have been many definitions of the term education, but the ones that appeal most to me are those which take into account the development of the human mind as a preparation for better living. That person may be considered educated who has learned to adjust himself to his surroundings, who can live comfortably and successfully under unusual conditions, who can turn defeat into victory and use obstacles as stepping stones to success. We may consider any one undeveloped educationally who has not learned to accommodate himself to the conditions under which he must live and to meet the problems of life with a stout heart and firm determination to do his part in making the world a better place in which to live. It is to one of these factors in mental development that I desire to call your attention for a few minutes this morning.

Much has been written concerning the value of research and its place in a modern educational system. There seems to be little doubt concerning the value of investigations which have to do with the control of diseases, the utilization of by-products or the increase of food production. The successful completion of such a project prolongs life, decreases the cost of living or tends to increase human happiness and so

¹ Honor's Day address at the University of Illinois.

they have a practical aspect which presents a strong appeal. But any undertaking which can not point in advance to a practical application, which will not fill a long-felt want or which can not be immediately commercialized in figures of astonishing size is frequently looked upon as a useless expenditure of time and money. Any discovery of which it must be said "it is of scientific interest only" has little interest for the practical man who wants results and who insists that our educational system must be so constructed and operated that it will turn out practical men and women of the everyday world.

But the value of research is not always easily determined, since its bearing upon life is usually not evident at first. When Newton discovered the law of gravitation its value was not appreciated; when Dr. Morton first used the principle of anesthesia it must have been regarded as a useless curiosity; when Lavoisier discovered the element, oxygen, the practical men of his day probably asked "What of it?"; when Pasteur announced his germ theory of disease, no one realized its importance. Yet from each of these investigations there has sprung a modern science which is contributing in a large way to the comfort, safety and well-being of the human race. These have been discoveries of basic importance, yet in their infancy they seemed impractical, visionary and of scientific interest only.

Previous to 1860 the methods of identification of new substances required tedious and painstaking work upon the physical and chemical properties of the material under examination. The invention of the spectroscope by Robert Bunsen permitted the study of gases and incandescent solids by noting the wave length of the light which each absorbed or emitted. Soon this instrument was recognized as furnishing an efficient means of detecting the presence of new elements, and in its various modifications, spectrum analysis has been directly responsible for the discovery of nearly all the elements since the spectroscope first became available. It was first used in studying the atmosphere of the sun in a total eclipse which was visible in India in 1868. As a result of this study, the eminent British astronomer Lockyer reported a bright yellow line whose wave length did not agree with that produced by any known substance. Accordingly it was concluded that there must be a substance in the sun's atmosphere which did not exist upon the earth. The name helium—the sun element—was given to this substance and for twenty-seven years scientists speculated about its nature and its relationship to the earth. In 1895 Sir William Ramsay discovered that helium could be extracted from certain minerals and in 1903 Cady and McFarland reported that certain natural gas supplies in

southern Kansas contained appreciable quantities of helium. Here was a succession of discoveries of great interest to scientists, but of so little practical application that they attracted little or no attention, and so they were all but forgotten. But when the Great War broke out and modern methods of military operation demanded the use of innumerable balloons for observation work, a new and serious problem arose. The gas hydrogen is inexpensive and efficient for the inflation of balloons, but it has one serious handicap—it is highly inflammable. A flash of lightning from a passing cloud, a flaming bullet from an enemy aeroplane or a spark from the dirigible's own motor and the balloon instantly becomes a roaring furnace with an appalling loss of life and property. An immediate and urgent demand arose for a light gas which would not burn and the only gas of that type known is helium. It was a courageous suggestion, for the largest quantity of helium which had been collected at that time was probably less than one hundred cubic feet and the cost was about \$1,700 per cubic foot. At that rate the value of the helium required to lift the simple weight of an average man would be over three and one half million dollars. The application of modern scientific methods to the purification of helium has decreased its cost thirty thousand fold and permitted the United States government to prepare enough of the gas to fill four of the ordinary type of kite balloons before the signing of the armistice. While the development of this project did not come soon enough to aid in saving life during the war, it has contributed much to the safety of aviation in lighter-than-air craft, and the generous supply of helium in this country is to be regarded as one of the most important items of defense at our command.

While we are proud of these developments and watch with interest the growing importance of helium in aviation and in scientific pursuits, we should not forget that the discovery of the element, the finding of commercial quantities, the methods of extraction, purification and use are all due to the culmination of problems of research in pure science, which at first seemed wholly impractical and without useful application.

But it should not be necessary at this time and in this place to multiply examples of this kind to prove the point that research frequently has an importance greatly in excess of the expectations of its promoters. Even if we admit that nine out of every ten research problems fail to benefit the human race directly, it is clear that the tenth is sufficiently important to overbalance the cost of all ten.

But why should business be interested in research? It is doubtless unnecessary to argue in favor of any investigation on such problems as the methods of in-

increasing sales, improving manufacturing processes or utilization of waste materials. The value of such undertakings is evident to all. But in what way is the American business man interested in problems of pure science which may have no apparent bearing at all upon his business? The history of American business has shown that all too frequently the value of scientific research is ignored with disastrous results to a business which seemed to be as well established as Gibraltar itself. Let us look for illustrations to prove this statement.

Several years ago a firm was organized to put on the market a new variety of food products. The process was original, the product attractive and soon a thriving business was established. The process involved many chemical steps and the firm employed a chemist to develop the details of the work. When the business had become well established and the profits were coming in nicely, the manager summoned the chemist to his office and said: "We are now well established, our process is working satisfactorily and we are satisfied with our products. We appreciate the help you have given us but after the end of this month we shall not need your services any longer." Shortly after this interview, the chemist removed to another state and lost contact with his former associates. After several years he returned for a visit, expecting to see a greatly enlarged and thriving factory. Imagine his disappointment when he found the doors nailed up and the windows bearing mute testimony to the unerring accuracy of missiles from the hand of the small boy. As he looked upon the scene of desolation there appeared above the door an inscription, invisible to all save him, in these familiar words: "We are satisfied with our product."

In January, 1925, there was a thriving industry in this country producing wood alcohol or methanol and its by-products by the distillation of wood. The total investment in this industry was more than \$100,000,000, while its annual production was about \$35,000,000. The industry was one of our most flourishing enterprises, securely entrenched and supplying an essential basic material to several important industries. Two months later this prosperous industry was seemingly on the verge of complete wreck with almost a complete loss of the invested capital. What had happened to produce so sudden and so complete a change? Methanol was being manufactured in Europe from cheap raw material and the product was being imported by the United States at a price much below the cost of manufacture from wood. The American manufacturers, feeling secure in their position as producers of an essential basic material, had failed to remember that chemists are able to make rapid strides in the development of chemical manufactures. Fail-

ing to appreciate the importance of fundamental research, they had allowed the chemists of both France and Germany to develop a new process which means the entire remaking of their industry. It not only appeared certain that our wood distillation industry was doomed, but it also seemed likely that we would be compelled to manufacture our methanol under license from the German patentee during the fifteen-year life of the patent. It is not to our credit to know that we are saved from such humiliation by a technicality of our own patent laws.

In one of our thriving mid-western cities there is a firm which may be called The People's Ice Company. Recently it enjoyed a practical monopoly in supplying ice to the homes, stores and factories in the entire community. Business was good and the future looked promising since growth was substantial and refrigeration is essential in the handling of food products. But in spite of optimism the sales began to drop off and the business was very evidently losing ground. Upon inquiry it was found that more and more the stores and homes were installing individual refrigerating plants which were operated by electric motor. It was evident that something must be done to save the business, for the days of the ice wagon seemed to be numbered. Investigation showed that the electric refrigerating process was based on well-known principles of physics and chemistry, so a group of scientific men was set at work to build an equipment which could compete with other devices of the sort. The experiment was successful and now The People's Ice Company is introducing its own appliances throughout the length and breadth of the land. By the time the ice wagon has disappeared from the city streets the business activities of the firm will be so completely adjusted to the new situation that the change will be welcome. In this case research has built a larger and broader business to meet the changing demands of a scientific age.

These illustrations are sufficient to indicate that research is a vital part of business if success is to continue in this rapidly advancing age of ours. Few industries are safe from the revolutionizing influences of scientific achievement unless they are constantly on the alert for the latest developments in their fields of endeavor. To discontinue research, to feel satisfied with the product, to fail to advance is to drop behind in the procession of modern scientific accomplishment. To attempt to stand still is to invite disaster in the rush of modern traffic.

Do these statements seem extravagant or over-enthusiastic? Is a scientist getting out of his field when he attempts to emphasize the importance of science in the business world? If so, then listen to a few sentences taken at random from an article on "Science

and the Investor" published in a recent number of one of our leading metropolitan commercial journals:

There is no business to-day whose welfare and interest are not bound up with chemistry. . . .

There is no industry that is not in danger of waking up to-morrow and finding that the chemist has made a discovery that might revolutionize it. . . .

No industry which does not command the resources of scientific laboratories can be regarded as secure. . . .

No investor or banker can feel sure that his interest in any security is secure in the absence of the assurance given by the knowledge that science is on guard. . . .

These quotations sound like the enthusiastic endorsement of an over-zealous chemist, but it must be remembered that they were written by a man who is not primarily a scientist, but the financial editor of one of our greatest business journals. His best advice to prospective investors in any business undertaking might be epitomized thus: "Be sure the institution is keenly alive to the importance of scientific research before investing in its securities."

Similar testimony has recently been given by the vice-president of one of the largest banking institutions in New York City. He was quoted as saying in substance:

When any New York banker is called upon to finance any corporation or business especially one based directly or indirectly upon scientific pursuits, the first investigation made is in regard to the attitude of the institution toward the advancement of scientific knowledge. If there is maintained a scientific laboratory with a generous regard for the advances in pure science, the security is, to that extent, considered good. But if no attempt is being made to keep up with, or a little in advance of the developments in science, then no considerable loan will be risked upon such a venture. Permanent business success is too intimately linked with scientific attainment to make any other attitude safe.

It is not to be presumed that these students of economic conditions had in mind any particular branch of science to the exclusion of others. For what is true in this respect concerning chemistry is true with equal force of physics, of engineering, of the social sciences, of business relations and many other lines of human endeavor which are touched by the advances of our modern civilization.

Perhaps all this seems far removed from the everyday problems of life. We might have little difficulty in reaching an agreement as to how research should be used to improve and stabilize big business, but how may it be applied to the everyday events and activities of our own existence? I believe the training received in investigational work and the mental attitude developed by it may be made a very potent factor in

education, which should after all be a training for a useful and full-rounded life.

Research has been defined as a careful or critical inquiry or examination in seeking facts or principles; a systematic investigation of phenomena by the experimental method, to discover facts or to coordinate them into laws; a critical examination of conditions as we find them with the desire to improve whenever possible. In simple language research may be regarded as childish curiosity, grown to maturity and given a college education. The term "pure research" is sometimes used to refer to pursuit of knowledge for its own sake, to a search after truth for truth's sake, without a thought of the present or future value of the results. Consequently, there is an element of unselfishness in pure research, and the seeker after truth has no concern in the practical value of his discoveries. Many of civilization's most notable achievements have resulted from this unselfish spirit of research workers; this spirit has blessed the world thousands of times and it is still the actuating motive of a very large army of workers in various fields of human endeavor.

One of the most valuable assets to be obtained through the medium of education is the ability to think clearly and to analyze a complicated problem, putting the various factors into their proper relationship and value. Such a process is as truly research as the discovery of unknown lands in the polar seas, the perfecting of a new method of combating disease or the building of a new chemical compound. If we can subject the ordinary problems of our life to the careful scrutiny of critical examination; if then we can apply to these everyday matters the spirit of pure research with the unselfish desire to improve, to benefit and to serve, then we shall in some small measure justify the existence of the system of education of which we are a part. Study your job intently, whether it be the running of a great railway system or of a disc harrow; whether you are called upon to preside over a legislature or a country school; whether you wield a scepter or a broom. Bring to your task the spirit of research, of improvement, of service and of devotion; for by so doing work becomes a joy, a blessing, a benediction.

I congratulate the honor students of the University of Illinois for the excellent accomplishments of the past. It is no small achievement to be selected from so large a student body for the distinction of Honor's Day. You are to be congratulated upon your ability to keep in mind the prime purpose of a college education as well as for the excellence of your classroom records. I hope you feel a real pride in this accomplishment and I trust that you are inspired with the

determination to win new marks of distinction in whatever line of activity you may engage. I hope you have enjoyed the work in which you have been employed, that you have worked industriously in working hours, that you have played intently in hours of recreation, and that you have enjoyed the companionship of your associates in hours of relaxation. If this has been your record, you richly deserve the honor which is extended to you to-day. But however great our satisfaction for the good work of the past, I congratulate you more heartily for the opportunities which are opening before you. You are soon to become active factors in a world sick of war, worn by strife and perplexed by intricate political and economic problems. There is a great need for men and women who have been trained to think, to weigh, to decide and to act. Become an investigator of conditions as you find them and do your best to improve wherever you can. I congratulate you most heartily for the opportunity for hard work, intelligent accomplishment and useful service.

"So long as men shall be on earth
There will be tasks for them to do,
Some way for them to show their worth;
Each day shall bring its problems new.

And men shall dream of mightier deeds
Than ever have been done before:
There always shall be human needs
For men to work and struggle for."

B. S. HOPKINS

UNIVERSITY OF ILLINOIS

THE NEED FOR TRAINING TAXONOMIC BOTANISTS¹

TAXONOMY is fundamental in its relation to other branches of botany in the sense that the correct identification of plants is the basis for all work which concerns the identity of species. Comparison of the results of investigations has value only in so far as there is certainty as to the plants compared. The cytologist compares the number of chromosomes in the allied species and their hybrids in a complex genus like *Rubus* or *Rosa*. The value of his conclusions depends on the accuracy with which his specimens have been identified. The pharmacist compares the oils derived from various species of oil grasses found in commerce. A taxonomist had to work over the group to which the oil grasses belong before the comparison was worthy of record. The proposition is so evident that further support would seem unnecessary.

¹ Read at the meeting of the Botanical Society of America, systematic section, held at Nashville, December 28, 1927.

I have shown in another place² that taxonomy was a dominant branch of botany during the early development of that science; that during the last half century taxonomy has lost that dominance; and that now, especially in this country, that branch of botany occupies a distinctly inferior position as compared to other branches. This unfortunate condition hampers the symmetrical development of botanical science as a whole. Taxonomy has its place as a primary coordinate branch of botany and its growth should be encouraged that it may keep pace with such other primary branches as physiology, morphology and genetics.

Within recent years the demand for exact information on the identity of species has become more insistent. This is noticeable in connection with the exploration and development of tropical regions. Those interested in the vegetable products coming from these regions wish to know the specific identity of the plants producing these. When chaulmoogra oil came into prominence in connection with leprosy it was found that the identity of the species producing it was uncertain. At once a taxonomic study of the group concerned was necessary. Information in such cases can be furnished only by the taxonomist. However, the number of taxonomists with sufficient training and experience is at present so limited that information can not be furnished as rapidly as wanted. In other words, the demand at present is far greater than the supply.

In another direction the demand exceeds the supply. It is now difficult to find trained young men or women to fill positions in taxonomy. At the present time there are positions awaiting properly qualified applicants, and there appear to be no such persons available.

The chief source of supply of people for positions requiring previous experience in taxonomy is the larger herbaria of the country of which there are few. The source of supply for these herbaria is the college graduates who have taken an interest in taxonomy and have specialized in that subject. In the main we must depend upon our colleges to equip students with sufficient training to fill positions requiring a fair knowledge of the principles of taxonomy. In my opinion the colleges are not doing this to the extent necessary. In fact I believe the colleges in the aggregate are not giving the attention to taxonomy indicated by its proportional importance as a primary coordinate branch of botany.

This condition appears to be due to two reasons, the lack of trained taxonomists in our colleges and the lack of interest in the subject itself. In the latter part

² "The Scope and Relations of Taxonomic Botany," SCIENCE, n.s., 43, pp. 331-342, 1916.

of the last century there was a gradual swinging away from taxonomy toward more recently developed branches such as morphology, ecology, cytology and genetics. The swing has been so great that few taxonomists were trained at the period when our present generation of teachers were in college. There are, therefore, few taxonomists of first rank in our colleges at present. This condition also accounts in part for the lack of interest in taxonomy among our undergraduate and postgraduate students. Consequently, taxonomy if taught as a distinct course is likely to be in the hands of a teacher whose primary interests are in some other branch of botany.

Assuming a desire to give the teaching of taxonomy a coordinate rank in the curriculums of our colleges, how can this be realized under the present conditions? I venture the following suggestions on what should be attempted as rapidly as practicable. It should be understood that taxonomy is now taught satisfactorily in a few of our educational institutions and there are a few taxonomists of high rank in charge of courses in taxonomy, but in the aggregate taxonomy is not receiving the attention that it should.

First, the larger universities should establish a division of taxonomy as a primary branch of the department of botany. The professor in charge of this division should be a taxonomist of first rank.

Second, the student should be given the same opportunity to specialize in taxonomy that is given in other branches of botany. This opportunity should include contact with the subject at the same time that he comes in contact with the other branches. It should include a sympathetic attitude toward taxonomy, that is, the student should be encouraged to specialize in taxonomy if he shows a liking for the subject.

It has been objected that the demand for professional taxonomists is so small that it is not worth while attempting to train them on the same scale as botanists in other lines are trained. This objection disappears when the subject is examined more closely.

In the first place I think it is not the function of undergraduate instruction in botany to train professionals. Even the instruction in postgraduate courses is scarcely of the nature to train professionals. Professional training with the taxonomist begins when he accepts a position in which taxonomy is the chief line of work. Such would be an assistantship in an herbarium or in state or federal government department. What our colleges should do is to give the student a training which will fit him for a position of this kind. It is true that professional positions in taxonomy are limited in number. It is also true that professional positions in other branches of botany are few. How many positions are there in which the occupant devotes himself to physiology, to genetics or to cytology?

I am not here referring to teaching positions except as the teacher devotes himself entirely to one of these subjects. On the basis of specialization I think there is as much demand for taxonomists as for specialists in other lines.

Many of the botanists who take postgraduate work in our educational institutions become teachers of botany. If they are adapted to the prosecution of research they specialize in some branch in which they are interested. Much of the research in botany at present is carried on by teachers for whom the research is a side line. They are professional teachers rather than professional research workers. In this connection, then, my plea is that taxonomy be placed on an equality with other branches of botany in our colleges, then those who have taken special training in botany will have had an opportunity to equip themselves for research in taxonomy. Those who become teachers and have the opportunity and the inclination to carry on research in taxonomy can do this as a side line. In this way the amount of taxonomic research in America would be greatly increased.

It is true that comprehensive work in taxonomy can be pursued only in connection with a large herbarium and botanical library. But much can be done by the isolated worker if he confines himself to a definite group. He can accumulate specimens and books dealing with this group. He can supplement this by borrowing books and specimens. He can give the final touches to a piece of work by visiting a large taxonomic center.

Every institution teaching botany should have an herbarium, not a large one to compete with the great botanical centers, but a small well-selected collection of plants which can be used as a laboratory for teaching taxonomic botany.

However, the basis for the proper development of taxonomic botany is first a realization of its importance and, second, a sympathetic attitude toward this branch in our colleges.

A. S. HITCHCOCK

WASHINGTON, D. C.

THE FIFTH NEW YORK MEETING OF THE AMERICAN ASSOCIATION AND ASSOCIATED SOCIETIES¹

PREPARATIONS for the fifth New York meeting of the American Association are much further advanced than is usual at this time. It is evident that this meeting will be larger and more important than any earlier

¹ This is the second announcement about the approaching New York meeting. The first announcement, by President Henry Fairfield Osborn, was published in SCIENCE for April 20.

meeting. Forty-one special scientific societies are planning to meet with the association on that occasion. A survey of available hotels and session rooms has already been made and the facilities have been shown to be ample for all needs.

Under the efficient and enthusiastic leadership of the president of the association, Professor Henry Fairfield Osborn, president of the American Museum of Natural History, several unusually attractive features are being planned for this meeting. It is hoped that those who come from away will arrive on Thursday, December 27, in time for the opening general session on Thursday evening and the general reception that is to follow it, and that they will remain throughout the period of the meeting, which will close with another general reception Wednesday evening, January 2. There is to be a general session of the association each evening at the American Museum. These general sessions on Friday, Saturday, Monday and Tuesday evenings are each to be devoted to a lecture by some eminent man of science, presenting interesting aspects of current progress in one of the larger science fields. These main public lectures are to be sufficiently non-technical to be useful to workers in other fields as well as to those in the respective fields of the lecturers themselves. Other general sessions for the same general purpose are being planned, and the fifth New York meeting will furnish exceptional opportunities for science workers in each field to become better acquainted with the recent accomplishments and aims of those in the other branches. This feature is being developed with the aim of counteracting to some extent the regrettable narrowing that inevitably results from modern specialization in science. While the special science societies and the sections of the association are devoted to the advancement of the several sciences, the American Association as a whole and the affiliated state academies of science need to give much attention to the broader aspects of science, the interlocking of all the many kinds of intellectual endeavor that together make up science in general. A social period is planned for each evening, following the general sessions, and those who attend are to have opportunity to examine the American Museum exhibits in the field of science to which the evening is specially devoted. These evening sessions will alone be well worth the trip to New York and the devoting of the entire week to science in the broader sense.

The retiring president of the association is this year Dr. Arthur A. Noyes, director of the Gates Chemical Laboratory of the California Institute of Technology. Dr. Noyes will deliver the retiring presidential address at the general session on Monday evening, December 31. The general session of Friday evening, December

28, is to be devoted to the annual Sigma Xi lecture, which is a regular feature of the annual meetings of the association. The lecturer will be chosen, as usual, by the Society of the Sigma Xi and his name will be announced in due time. A concert is being planned for Sunday afternoon and excursions to scientific institutions in and near New York are to be arranged for Sunday forenoon and for other times.

Reduced railway fares are being arranged for those who attend the New York meeting, which will amount to a fare and a half for the round trip. Plans are being made by which the validation of railway certificates may be accomplished with a minimum of trouble on the part of those who register. It is likely that there will be several registration offices, since scientific sessions will be held at several places.

The registration fee for the meeting is to be two dollars and each registrant is to receive the official badge, a copy of the "General Program," together with such program supplements as may be published, any other literature issued in connection with the meeting and an identification card entitling the recipient to all the privileges of the meeting, including the endorsement and validation of one railway certificate. But members of the American Association for the Advancement of Science who have been enrolled for the year 1928-29 may register by paying only one dollar. To secure the benefit of this lower registration fee one must be a life member of the association or an annual member whose current dues have been paid. Enrollment cards for 1928-29 will be issued from the Washington office to all life members on October 1, and to annual members upon receipt of dues for 1928-29, which are due October 1. These cards should be brought to the meeting and should be shown at the registration office in order to obtain the benefit of the lower registration fee.

Associates for the fifth New York meeting are to pay the regular associate fee of five dollars and are not to pay any registration fee. The associateship is provided for those who are willing to contribute to the meeting fund but who do not care to become members of the association. Associates do not receive the association journal, but they are to receive the special issues of SCIENCE that contain the reports of the meeting. They have all the privileges of the meeting except voting. All associate fees collected for this meeting, as well as registration fees and all entrance fees of new members who join at this meeting, are to go into the meeting fund, which is to be used for paying the extra expenses of the meeting.

A list of hotels and room prices will be published in SCIENCE as soon as assignments of hotel headquarters shall have been made by the local committee in charge of that feature of the preparations. It is hoped that

reduced prices may be arranged for those from away who plan to stay in New York for Science Week. There are plenty of medium-priced hotels in the city and there will be no dearth of suitable rooms, but early reservation of rooms will be desirable. Reservations are to be sent directly to the hotels, after the appearance of the list showing the hotel headquarters of the several societies that are to meet with the association this year. The secretaries of these organizations will be promptly informed about hotel headquarters, prices, etc., so that they may transmit this information to their members.

The names of the forty-one organizations that have thus far intimated their intention to meet with the association in New York are as follows. Names of those that are officially affiliated with the American Association are indicated by one or two asterisks. One asterisk shows that the organization has one representative in the association council and two asterisks show that it has two representatives. Other officially associated societies are each indicated by a cross:

Organizations related to Section A (Mathematics)

- **American Mathematical Society
- **Mathematical Association of America

Organizations related to Section B (Physics)

- **American Physical Society
- *American Meteorological Society

Organizations related to Section D (Astronomy)

- **American Astronomical Society

Organizations related to Section E (Geology and Geography)

- **Geological Society of America
- **Paleontological Society of America
- *Mineralogical Society of America
- **Association of American Geographers
- †National Council of Geography Teachers

Organizations related to Section F (Zoological Sciences)

- **American Society of Zoologists
- **Entomological Society of America
- **American Association of Economic Entomologists
- *American Society of Parasitologists
- Phi Sigma Biological Research Society

Organizations related to Section G (Botanical Sciences)

- **Botanical Society of America
- **American Phytopathological Society
- **American Society of Plant Physiologists
- †Sullivant Moss Society
- †American Fern Society

Organizations related to both Sections F and G

- **American Society of Naturalists
- **Ecological Society of America
- **American Microscopic Society
- Genetics Section of American Society of Zoologists
and Botanical Society of America
- Geneticists Interested in Agriculture

Organizations related to Section H (Anthropology)

- **American Anthropological Association
- †American Folk-Lore Society

Organizations related to Section I (Psychology)

- **American Psychological Association

Organizations related to Section K (Social and Economic Sciences)

- †Metric Association

Organizations related to Section L (Historical and Philosophical Sciences)

- *Linguistic Society of America
- **History of Science Society

Organizations related to Section O (Agriculture)

- **American Society of Agronomy
- *Society of American Foresters
- *American Society for Horticultural Science
- †Potato Association of America
- †Gamma Sigma Delta Honor Society of Agriculture

Organizations related to the American Association as a whole

- **Society of the Sigma Xi
- **American Association of University Professors
- †Gamma Alpha Graduate Scientific Fraternity
- *American Nature-Study Society
- Sigma Delta Epsilon Graduate Women's Scientific Fraternity

As has been said, the fifth New York meeting will be unusually large, but it promises to be really less crowded than some of the smaller meetings have been. It is hoped that the society meetings may be distributed throughout the week so that the two halves of the meeting period (separated by Sunday) will not be very unequal in this respect. This meeting is to be specially interesting and unusually satisfactory on account of the inclusion of a Sunday in the period. This will offer exceptional opportunities for committee meetings, personal consultations, excursions to interesting points in the city, etc.

There will be no lack of suitable rooms to supply the needs of the numerous sections and societies. Some of these will meet in the American Museum and most of the remainder will meet at Columbia University, which cordially offers its very excellent facilities. Earlier New York meetings of the association and the associated societies have been held at the university, as those who have attended those meetings will remember with pleasure and satisfaction.

The great annual science exhibition, which has recently become a very important feature of the association meetings, will be especially large and valuable this year. A large number of firms that supply scientific apparatus for research and teaching and many publishers of scientific books are to take part. There will be an unusual number of exhibits by research workers and research institutions and laboratories.

Those who have new apparatus, methods or results that will be suitable and available for the New York exhibition should take up this question at an early date, by correspondence with the permanent secretary's office in Washington. Since many research workers are apt to be somewhat overmodest in bringing their work forward, those who know of apparatus and methods recently developed by others are asked to inform the permanent secretary, so that invitations may be sent out to secure as valuable and as representative scientific exhibits as may be had. Arrangements for this important feature of the exhibition should be taken up early, before October 1, for considerable correspondence will probably be necessary in each case and the press of other matters will be very great in the fall. The location of the general exhibition will be announced later. It will be convenient for those who attend the meeting and will be unusually valuable and attractive. The assignment of space for the commercial exhibits is in charge of Major H. S. Kimberly, manager of the exhibition.

An important feature of the New York meeting will be one or more sessions of the Secretaries' Conference, which has recently been organized under the special secretaryship of Dr. George T. Hargitt, Lyman Hall, Syracuse University. Another important feature will be a session and a complimentary dinner of the Academy Conference, also recently organized, the secretary of which is Dr. Howard E. Enders, Purdue University, Lafayette, Ind. The secretaries' complimentary dinner is planned for Sunday evening. That of the academy conference will probably occur Thursday evening. The first session of the executive committee of the association will be held at the general-headquarters hotel Thursday morning at 10 o'clock and the first council session will be held Thursday afternoon at 2 o'clock, after which will occur a session of the academy conference.

It is very desirable that as many as possible of the preliminary plans for the great New York convention in Science Week shall be completed before June. Little can be accomplished during the summer and both the local committees and the Washington office will be very busy after October 1. Correspondence about local arrangements should be addressed to Dr. Sam F. Trelease, American Association for the Advancement of Science, American Museum of Natural History, 77th St. and Central Park West, New York City. Carbon copies of all such communications should be sent, at the same time, to the permanent secretary's office, American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D. C. Correspondence about space to be occupied by commercial exhibits in the general exhibition should be addressed to Major H. S. Kim-

berly, American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D. C. Communications about scientific exhibits, by investigators and research workers, should be addressed to the permanent secretary.

Further notes concerning preparations for the fifth New York meeting will be published in SCIENCE as these become available and the "Preliminary Announcement" of the meeting will appear in the issue of SCIENCE for November 30.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC EVENTS

THE INTERNATIONAL POPULATION UNION

AT the last session of the World Population Conference in Geneva, on September 3, 1927, there were passed the following resolutions:

The World Population Conference resolves that a permanent international organization be created for the object of studying population problems in a strictly scientific spirit.

A Provisional Committee is hereby authorized to prepare the constitution for this organization.

In accordance with these resolutions the following Provisional Committee for the organization of an International Union for the Scientific Investigation of Population Problems was then appointed, with power to coopt additional members until the total number of the committee was fifteen:

Representing	
Sir Bernard Mallet	United Kingdom of
Professor F. A. E. Crew	Great Britain
Professor E. M. East	United States of
Professor Raymond Pearl	America
Professor Leon Bernard	France
Professor Erwin Baur	Germany
Professor Corrado Gini	Italy
Professor W. Rappard	Switzerland
Professor A. Mahaim	Belgium

Under the power granted for cooptation the following persons have been added to complete the committee:

Representing	
Professor Severino Aznar	Spain
Professor Kiyo Sue Inui	Japan
Professor H. Lundborg	Scandinavia
Professor J. H. dePaula Souza	South America
Doctor Charles H. Wickens	British Dominions
Professor V. Bunak	Russia

The committee organized at Geneva and appointed Raymond Pearl, chairman, and Professor F. A. E. Crew, secretary.

Since last September this committee has been actively engaged in the preliminary work of the organization of the union, with the financial and moral aid and support of the National Research Council and the Social Science Research Council, acting in co-operation. A provisional draft of the statutes of the union is now in process of revision. The general plan of organization proposed is closely similar to that of other existing International Unions in the pure and applied sciences, with such differences only as are necessitated by the manifold and wide-ranging character of population problems. The basis of the union will lie in national committees in the various adhering countries, these underlying national organizations being composed of scientific men interested and active in research regarding various aspects of population. Such national committees have already been formed for Great Britain, France, Italy and the United States, and are in process of organization at the present time in a number of other countries. In the case of the United States committees on population have been appointed by the National Research Council and the Social Science Research Council, respectively, which bodies, acting conjointly, will be the official adherents to the union for this country.

The provisional committee will meet in Paris on July 2, 1928, for the purpose of finally completing the preliminary organization of the union, the first General Assembly of which will take place in Paris on July 4-6, 1928. According to the plan of organization provided for in the statutes, membership in the general assembly of the union will be restricted to delegates officially elected by the national committee of the adhering countries. In addition to the members a limited number of persons may be invited by the general assembly itself to attend its sessions.

The objects of the International Union will be purely scientific. Propaganda of any sort, for any purposes whatsoever, will have no place in its activities.

The purpose of the union will be to develop scientific studies pertaining to the problems of population, and particularly:

- (a) To initiate and organize researches which depend upon international cooperation, and to provide for their scientific discussion and publication.
- (b) To facilitate the establishment of common standards for the collection, tabulation and analysis of data regarding human populations, including economic, sociologic, demographic, agricultural and biologic data.
- (c) To serve as a clearing house for the interchange and dissemination of information about population, especially for the purpose of facilitating research.

- (d) To cooperate to the fullest extent with other scientific bodies having similar objects.

RAYMOND PEARL,
Chairman of the Provisional Committee

INTERNATIONAL CONFERENCES IN 1928

THE Institute of International Education of New York has issued a list of international conferences to be held during the present year. These include the following in the fields of science:

- April 9-11, Fifth International Congress of Refrigeration, Rome.
- May 26-29, Sixth International Congress of Doctors, Naturalists and Engineers, Prague.
- June 3-9, One Hundredth Anniversary of Institution of Civil Engineers, London.
- June 21-24, International Congress of Geologists, Copenhagen.
- June 26-July 14, World's Dairy Congress, London. The program includes papers on all phases of milk industry.
- July 5, Meeting of the International Astronomical Union, Leyden, representing twenty-three countries.
- July 14-23, International Geographical Congress. Meets in London and Cambridge. In addition to the general meetings there will be meetings of six sections.
- July 23-27, International Congress of Radiology, Stockholm.
- July 23-28, Thirty-second session of the Congress of Alienists and Neurologists of the French-speaking world, Antwerp.
- July,* International Convention on Cancer Research, London. Persons and organizations conducting research on cancer are invited to attend.
- Summer,* International Health Congress, Havre and Paris. To consider the extermination of rats.
- September 3-10, International Congress of Mathematicians, Bologna.
- September 4-October 6, World's Power (Fuel) Congress, London. The technical program will be divided as follows: Composition and Classification of Fuels; Preparation of Fuels; Storage, Handling and Transmission of Fuels, and Utilization of Fuels.
- September 10-14, International Psychotechnical Congress, Utrecht.
- September 25-27, International Union against Tuberculosis, Rome.
- September 28, International Congress on Iron and Steel, Bilbao.
- September,* International Congress of Doctors, Budapest.
- October 7-28, International Conference on Aerial Navigation, Berlin.
- October,* International Technical Congress, Tokyo.
- October,* International Congress of Microbiology, Paris.
- November 19-24, Second International Conference on Bituminous Coal, Carnegie Institute of Technology, Pittsburgh.

November,* Second International Conference for the Protection of Plants, Rome.

November,* Ninth general meeting of the International Agricultural Institute, Rome.

December 15-22, International Congress of Tropical Medicine, Cairo.

FORESTRY ADVANCES IN THE UNITED STATES

THE official *Record* of the U. S. Department of Agriculture lists the more important advances in forest conservation which have been made in various states. Last year three states—Florida, South Carolina and Delaware—passed laws for the establishment of state forestry departments and the appointment of state foresters. Similar legislation was again proposed in Arkansas but failed. California created a department of natural resources under the general supervision of a director, with a division of forestry administered by the state forester and guided as to policies by a state board of forestry, the new department taking over all the powers and duties of the former state forester. Rhode Island made an important change in its forestry organization by putting it under the department of agriculture. North Carolina increased the membership of its state board of conservation and development. Louisiana provided for an additional member of its forestry board. Ohio passed legislation authorizing the board of control of the Ohio experiment station to acquire tracts suitable for research and demonstration in practical forestry. Maine provided for the establishment of town forests, and Wisconsin made similar provision for county forests. In Washington the State has been given authority to exempt from counties tax lands suitable for State forests. Michigan provided for the retention of such lands by the state, and Minnesota set aside as state forests all state lands within the boundaries of the Minnesota National Forest. Pennsylvania appropriated \$450,000 toward the acquisition of about 7,200 acres of private land in order to preserve some of the original forests of the state, and for other forests and tracts subject to the contribution of not less than \$200,000 of private funds for the same purposes. Maryland authorized the formation of auxiliary state forests through agreement with private land-owners.

DR. B. L. HARTWELL AND THE RHODE ISLAND AGRICULTURAL EXPERIMENT STATION

THE New England section of the American Society of Agronomy has passed the following resolutions concerning Dr. B. L. Hartwell:

*The information in the possession of the Institute does not give the exact date.

WHEREAS, Dr. B. L. Hartwell, during his many years of service at the Rhode Island Agricultural Experiment Station, has made many notable contributions to agricultural science, winning for himself and the Rhode Island station a national and international reputation; and

WHEREAS, The success of the investigations at the Rhode Island station in Dr. Hartwell's special field is largely the result of carefully planned and fostered cooperation of the station agronomists, chemists and plant physiologists; and

WHEREAS, The Rhode Island station experiments and researches respecting soil acidity, availability of phosphates, toxicity of aluminum, effect of one crop on another, crop response to fertilizer elements, manure substitutes for vegetable gardens, etc., have yielded results of incalculable value to agronomical science and practice; and

WHEREAS, Dr. Hartwell has taken an active part in the proceedings of the New England section of the American Society of Agronomy, working always for the best interest of New England agriculture through the promotion of agronomical science; has been known for his integrity, staunchness and untiring zeal; has been one whose counsel has been often sought and always esteemed by his fellow agronomists; and

WHEREAS, The New England agronomists feel that on account of Dr. Hartwell's long contact and detailed familiarity with the Rhode Island field experiments, into which he has put the best part of his life, his dismissal will cause agronomic science and New England agriculture to suffer a great loss and thereby affect the welfare of the people of New England; and

WHEREAS, The New England agronomists view with alarm any changes that would jeopardize the work, and with disfavor the summary dismissal of a scientist of Dr. Hartwell's record, character and ability, without a careful consideration of all the elements involved in the case; therefore, be it

Resolved, That the New England Section of the American Society of Agronomy earnestly requests a thorough investigation of the whole affair by some unprejudiced agency of Rhode Island, that the facts ascertained be made public, and that the board of managers of the experiment station keep an open mind for a reconsideration of its action in the light of the facts. Be it further

Resolved, That a copy of these resolutions be sent to Providence papers, the board of managers of the Rhode Island State College and to all other organizations or persons interested.

By A. B. BEAUMONT,

Chmn. New Eng. Sec. A. S. A.

FORD S. PRINCE,

Sec'y New Eng. Sec. A. S. A.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM H. WRIGHT, astronomer of the Lick Observatory, has been awarded the Henry Draper medal of the National Academy of Sciences.

DR. W. NERNST, professor of physical chemistry in the University of Berlin, has been awarded the Franklin medal of the Franklin Institute of Philadelphia.

THE University of St. Andrews will confer the honorary degree of LL.D. upon Professor William Darrach, dean of the college of physicians and surgeons of Columbia University, and on Dr. E. P. Catheart, Gardiner professor of physiological chemistry at the University of Glasgow.

THE Bavarian Academy of Sciences has elected to its mathématiques and natural history section as corresponding members the following: Dr. F. G. Hopkins, professor of biochemistry in the University of Cambridge; Dr. R. Robinson, professor of organic chemistry in the University of Manchester; Dr. S. Murbeck, professor of botany in the University of Lund; Dr. A. Angeli, professor of organic chemistry in the University of Florence; Dr. L. Dolle, professor of geography and paleontology in the University of Brussels.

DR. A. W. HILL, director of the Royal Botanic Gardens, Kew, attended the annual meeting of the New Zealand Institute on January 26, when he was elected an honorary member. Sir John Russell, director of the Rothamsted Experimental Station, has also been elected an honorary member of the institute.

THE Nichols Prize of the Royal Society of Medicine has been awarded to Dr. Peter L. McKinlay and Dr. Remington Hobbs, the prize being equally divided between them. This prize, of £250, under the will of the late Dr. R. T. Nichols, is offered every three years for the most valuable contribution by a British subject towards the discovery of the causes and the prevention of death in childbirth from septicemia.

DR. HEINRICH KAYSER, who was for twenty-five years professor of physics in the University of Bonn, recently celebrated his seventy-fifth birthday.

A PORTRAIT of Dr. William H. Park, director of the laboratories of the New York City Department of Health, professor of bacteriology and hygiene in New York University and Bellevue Hospital Medical College and vice-president of the New York Academy of Medicine, was presented to the academy at a stated meeting on April 19.

AT Tulane University, Dr. Erasmus Darwin Fanner has been appointed professor emeritus of orthopedics and surgical diseases of children and Dr. Rudolph Matas, professor emeritus of general and clinical surgery.

DR. FRANK C. WHITMORE, chairman of the division of chemistry and chemical technology of the National

Research Council and head of the department of chemistry at Northwestern University, has been elected a director of the American Chemical Society, to fill the vacancy created by the election to the presidency of S. W. Parr, of the University of Illinois.

DR. JOHN B. WHITEHEAD, professor of electrical engineering and dean of the school of engineering of the Johns Hopkins University, has been engaged as a consultant for the engineering and research staffs of the General Cable Corporation. He is to act in an advisory capacity on wire and cable insulations.

DR. HARRY EVERETT BARNARD, of Illinois, president of the American Institute of Baking in Chicago, has joined the scientific organization of the Royal Baking Powder Company as technical consultant, with headquarters in Indianapolis.

DR. A. S. PATTEN, for the past twenty-two years chemist at the Michigan Agricultural Station, has resigned to take a position with the Huron Milling Company, Michigan.

C. E. DOBBIN has been transferred from the fuel section of the geologic branch to the conservation branch of the U. S. Geological Survey, of which he is to be field representative of the mineral classification division, with an office in Denver, Colorado.

DR. JOHN COLLINSON, Jr., has been appointed head of the bureau of vital statistics of the Maryland Department of Health on a full-time basis to succeed Dr. Frederic V. Beitler, resigned.

DR. OTTO H. SCHWARZ has returned after about seventeen months abroad to become obstetrician-in-chief at the new maternity hospital and to head the department of obstetrics at the Washington University School of Medicine, St. Louis.

COMMANDER RICHARD E. BYRD has made public the membership of his forthcoming Antarctic expedition, which includes the following scientific men: Dr. L. M. Gould, of the University of Michigan, will be geologist and geographer; William C. Haynes, of the U. S. Weather Bureau, meteorologist, and Dr. Francis D. Coman, of the Johns Hopkins Hospital, physician and surgeon.

PAUL C. STANLEY returned to Washington on April 2, after spending four months in botanical field work in Honduras. Most of the time was devoted to a survey of the Lanceilla Valley, near Tela, but three weeks were passed in exploration of the pine forests of the interior of the Republic.

DR. GRAHAM LUSK, professor of physiology at the Cornell University Medical College, gave a series of three lectures under the Herter foundation of the University and Bellevue Hospital Medical College, New

New York University, on April 23, 25 and 27. The subjects were, respectively, "Normal Metabolism," "Diabetes" and "Mechanical Work."

DR. ROBERT A. MILLIKAN, of the California Institute of Technology, will be the principal speaker at the dedication exercises on April 28 of the new science hall at Berea College and Allied Schools.

DR. GEORGE E. COGHILL, member of the Wistar Institute, will lecture on the subject of "Anatomy and the Problem of Behavior" at University College, London, on May 7, 8 and 10.

DR. J. FRANK, professor of experimental physics at the University of Göttingen, will lecture before the New York University Chapter of the Society of Sigma Xi, May 2, on "Connections between Spectroscopy and Chemical Reactions."

DR. FRANK SCHLESINGER, director of the Yale Observatory, lectured before the Amateur Astronomers Association at the American Museum of Natural History on April 19.

DR. S. BURT WOLBACH, Shattuck professor of pathologic anatomy at the Harvard Medical School, delivered the annual lecture to the Philadelphia Pathological Society on April 19 on "The Pathology of Avitaminoses."

DR. CHARLES H. MAYO, of the Mayo Clinic, delivered the Balfour lecture on Lister day, April 5, at the University of Toronto on "Focal Infection in Chronic and Recurring Diseases."

DR. ALEŠ HRDLIČKA, of the Smithsonian Institution, gave three public lectures at the University of Wisconsin on March 26, 27 and 28 on "The Origin of the Living Races of Man, their Spread over the World and their Present Classification," "The Racial Composition of the Principal Now-existing Nations of the World" and "The American People."

DR. F. E. LLOYD, MacDonald professor of botany in McGill University, gave two lectures at Purdue University, on April 16. In the afternoon he addressed the local biological society and the Purdue section of the plant physiologists on "Maturation and Conjugation in Spirogyra." In the evening he gave a popular lecture on "The Structure, Movements and Feeding Habits of Vampyrella Lateritia" at an open meeting under the auspices of the department of biology and the Purdue Chapter of Sigma Xi.

DR. JULIUS BAUER, professor of medicine at the University of Vienna, gave a Mayo Foundation lecture on April 2, on "Individual Constitution in Clinical Pathology," at the Mayo Clinic. Dr. Bauer came from Vienna to deliver the oration at the recent meet-

ing of the American College of Physicians in New Orleans.

PROFESSOR BRUNO BLOCH, director of the dermatological clinic of the University of Zurich at Strasbourg, will lecture at the Harvard Medical School on April 16, on "Formation of Pigment in the Skin."

AMONG the busts to be unveiled in the Hall of Fame at New York University on May 10 is that of Louis Agassiz. The bust is the work of Anna Vaughn Hyatt, the daughter of Alpheus Hyatt, who was a student of Agassiz.

A. LEROY KEYES, bacteriologist at the Rocky Mountain Spotted Fever Laboratory, of the U. S. Public Health Service, at Hamilton, Montana, recently died of the disease, which he had contracted in the laboratory.

DR. CHARLES S. BOYER, of Philadelphia, known for his studies of Diatomaceae, recently died at the age of seventy-two years.

PROFESSOR LAUNCELOT HARRISON, Challis professor of zoology in the University of Sydney and president of the Linnean Society of New South Wales, died on February 20.

M. FÉLIX HENNEGUY, professor of comparative embryology at the Collège de France, Paris, since 1900, and president for five years of the Société de Biologie, has died, aged seventy-seven years.

PROFESSOR ANTONIO ABETTI, formerly director of the Institute of Astrophysics at Florence Arcetri, died on February 20 at the age of eighty-two years.

PROFESSOR RITZEMA Bos, known for his work in connection with the diseases of plants, has died at Wageningen, Holland, at the age of seventy-eight years.

THE Harvey Society of New York announces a celebration to commemorate the three hundredth anniversary of the publication of "Exercitationes de Motu Cordis et Sanguinis," by William Harvey, for the evening of Friday, May 11. The Harvey Society plans to celebrate the anniversary of this event in connection with the final lecture of the current year. The celebration is to consist of a dinner, in accordance with the ancient tradition established by Harvey at the Royal College of Physicians of London. After the dinner there will be an address, appropriate to the occasion, by Dr. Alfred E. Cohn, of the Rockefeller Institute. At the same time there will be an exhibition in the library of the Academy of Medicine a collection of Harveiana, arranged by Archibald Malloch, librarian of the academy.

THE Lehigh chapter of Sigma Xi was installed at Lehigh University on March 1, by Dr. G. B. Pegram, of Columbia University, the national treasurer of the society. There were thirty-nine charter members. The installation ceremony was followed by a banquet in the evening. The chapter elected the following officers: Dr. C. R. Richards, president of Lehigh University, *president*; Dr. B. L. Miller, *vice-president*; Dr. C. C. Bidwell, *treasurer*, and Dr. L. L. Smail, *secretary*.

THE annual meeting of the New Hampshire Academy of Science will take place at the Ashworth Hotel at Hampton Beach from June 1 to 3. Plans for the meeting include a general meeting addressed by an outside speaker, sessions for the reading of scientific papers and field trips.

THE fourth annual science dinner of the New York Association of Biology Teachers will be held on April 28 at the Hotel St. George, Brooklyn, N. Y. The program includes addresses by Dr. W. D. Bancroft, chairman of the department of chemistry at Cornell University; Dr. C. E. Baer, New York state supervisor of science, and Dr. F. C. Brown, director of the Museum of the Peaceful Arts.

GIFTS to the American Chemical Society aggregating \$360,000, for "cooperative service in recording and indexing through the society's publications the chemical literature of the world," were announced at the society's closing session in St. Louis. The Chemical Foundation, Inc., of New York, of which Francis P. Garvan is president, gave \$250,000. The remaining \$110,000 came from the industries, among which a leading donor was the Allied Chemical and Dye Corporation, of which Dr. William H. Nichols, of New York, a charter member and a past president of the society, is chairman of the board.

THE Northeastern Section of the American Chemical Society has received a check for \$1,000 from Mrs. Robert W. Neff as a contribution to the permanent trust fund of the section. Mr. Neff, who was a manufacturing chemist in Boston for thirty years, died a few weeks ago. He was a member of this section and was also treasurer of the board of trustees of this fund. He was deeply interested in the plans to provide a permanent source of income for the section and made provision in his will for this addition to the fund of which the income only can be spent for constructive work in chemistry by the Northeastern Section.

THE Academy of Natural Sciences of Philadelphia has received by bequest of the late Frank R. Mason, of Philadelphia, the important collection of Coleoptera accumulated by him over a period of nearly thirty

years. The collection is especially rich in exotic species, and includes among other series the Cerambycidae of the famous Vanderpole collection and the Angell collection of Carabidae. The Mason collection contains representatives of 16,863 species and embraces about 76,650 specimens, contained in over 1,100 boxes housed in nine large steel cabinets. The collection of the family Carabidae alone contains about 10,200 specimens representing 2,338 species, while the series of Cerambycidae contains individuals of 4,660 species. The technique of the specimens in the collection is said to be exceptionally fine. By the terms of the bequest the collection is to be kept intact and to be known as the "Frank R. Mason Memorial Collection." It has been considered by competent students to be the best collection of the beetles of the world in America.

THE New York Botanical Garden has recently received from the American Museum of Natural History a collection of more than five hundred herbarium specimens from Mount Roraima, collected in 1927 by Mr. G. H. H. Tate, of the museum staff. Roraima stands at the boundary corner between Brazil, Venezuela and British Guiana, and rises to a height of more than 8,000 feet. Its flora is still imperfectly known, chiefly because of the difficulty involved in reaching it, but has long been noted for a large proportion of endemic species. Mr. Tate was able to spend two weeks on the actual summit of Roraima and collected specimens of every observed species, so that the gift is an important addition to the garden's South American material.

CONTRIBUTIONS toward the \$1,000,000 sought by the Charles Sprague Sargent memorial fund for the Arnold Arboretum now total \$906,551, according to an announcement made by Henry James, chairman of the New York committee for the fund. This amount includes a \$50,000 gift which will be payable by Edward S. Harkness when the balance of the fund has been subscribed.

THE San Diego Society of Natural History has announced that in response to its appeal for a \$250,000 building fund, pledges to the amount of \$125,000 have been received. This building fund will make possible the erection of a new fireproof museum structure.

AT a recent meeting of the board of directors of the Desert Sanatorium of Southern Arizona, Tucson, \$250,000 was voted to establish an institute of research to study the nature of solar radiations and their effects on living matter. The director will be Dr. Bernard L. Wyatt; the medical director, Dr. Roland A. Davison, and the research consultant, Dr. Daniel T. MacDougal.

THE *British Medical Journal* states that a national fund is being created in Sweden for presentation to King Gustaf V as a gift on his seventieth birthday in June this year. The King intends to expend the fund in promoting cancer research. A special institute may be established in Stockholm.

THE original thesis presented by David Starr Jordan for his master's degree at Cornell University has been given by Dr. Jordan to the university library. Dr. Jordan, a graduate of the class of 1872, prepared for his master's degree a manuscript on "The Wild Flora of Wyoming County, New York."

AN advisory commission of engineers has been organized to make a survey in Vermont with a view to preventing floods. J. W. Votey, dean of the University of Vermont College of Engineering, was named chairman of the commission and Professor H. K. Barrows, of Boston, consulting engineer. The commission plans to establish a number of stations along various streams to determine the flow of water at various times and under different conditions. From the data thus obtained, the locations of reservoirs to control the water flow will be determined.

CONTINUING its program of scientific research in cooperation with the United States Bureau of Mines and two advisory boards representing the mining and metallurgical industries, the Carnegie Institute of Technology in Pittsburgh will award ten fellowships in mining and metallurgical research during the coming year. Subjects to be studied by the fellows appointed for 1928-29 will be selected in the fields of origin and constitution of coal, coal mining, utilization of coal, mine safety and the physical chemistry of steel making.

ACCORDING to *Industrial and Engineering Chemistry* the Imperial Chemical Industries, Ltd., the British trust of which Sir Alfred Mond is chairman, has launched a move in England to promote chemical industrial research and stimulate interest in the chemical industry in general. To this end a research council composed of leading scientific men has been established. It is pointed out that coordinated industrial research in Great Britain has suffered in the past through lack of sufficient close associations with the academic and scientific world. The main functions of the council will be advisory, and it will act as a clearing house for ideas. The council will also provide close liaison between the industry and the universities, and will promote research along both industrial and purely academic lines. Sir Alfred Mond is chairman of the council. In further extension of this move the British chemical trust has also inaugurated a scheme to absorb research chemists and chemical engineer graduates from British educational in-

stitutions. The plan provides for selecting boys who indicate an aptitude along chemical lines and insuring them positions with initial salaries of \$2,000 per year upon successful completion of their educational training in universities.

UNIVERSITY AND EDUCATIONAL NOTES

THE will of the late Chauncey M. Depew, of New York, includes an unrestricted bequest of \$1,000,000 to Yale University.

ST. STEPHEN'S COLLEGE at Annandale-on-Hudson has been absorbed by Columbia University, according to an announcement by the officials of both institutions. Under the consolidation St. Stephen's becomes a unit of Columbia University on a parity with Columbia and Barnard Colleges.

THE *Journal of the American Medical Association* states that at a luncheon given by the University of Southern California in honor of Dr. Ray Lyman Wilbur, of Stanford University, and a group of sixty Los Angeles physicians on March 26, it was announced that the University of Southern California College of Medicine is to be reopened and that the trustees have agreed to set aside \$500,000 as an endowment.

GROUND was broken with formal ceremonies at Lafayette College on April 26 for the John Markle mining building.

DR. CHARLES P. OLIVIER, of the University of Virginia, has been appointed professor of astronomy at the University of Pennsylvania and director of the Flower Observatory at Highland Park.

DR. RAOUL BLANCHARD, professor of geography at the University of Grenoble, has been appointed professor of geography at Harvard University.

DR. S. TIMOSHENKO, of the research department of the Westinghouse Company, has been appointed professor of applied mathematics at the University of Michigan. He is succeeded at the Westinghouse Company by Dr. A. Nádai, of Göttingen.

PROFESSOR F. C. KOCH has been made chairman of the department of physiological chemistry and pharmacology at the University of Chicago. Professor A. Baird Hastings has been transferred from the department of physical chemistry to be professor of biochemistry in the department of medicine.

AT Clark University, the following promotions from associate professorships have been made: Dr. W. Elmer Ekblaw, professor of agricultural geography; Dr. Clarence F. Jones, professor of economic geog-

rathy; Dr. John P. Nafe, professor of experimental psychology. Oscar W. Richards has been appointed assistant professor of biology.

At Rutgers University, Dr. Albert O. Hayes has been appointed full professor of geology and head of that department. He has served during the past two years as visiting professor of geology.

DR. CARL STEVENSON, of the University of Chicago, has been appointed acting professor of medical history at Cornell University, Ithaca, for the second term of the coming year, during the absence on leave of Professor Preserved Smith.

THE following promotions have been made in the department of chemistry at Princeton University: Assistant Professor Gregg Dougherty, to the rank of associate professor; instructors William T. Richards, Francis B. Stewart and Thomas J. Webb, to the rank of assistant professor.

DR. A. E. CAMERON, professor of zoology and entomology in the University of Saskatchewan, has been appointed lecturer in medical entomology in the department of zoology of the University of Edinburgh.

DR. JOHANNES WEIGELT, professor of geology in the University of Halle, has been appointed to the chair of geology in the University of Greifswald.

DR. HERMANN STEUDEL, of the department of physiology in the University of Berlin, has been made a full professor.

DISCUSSION AND CORRESPONDENCE

A NOTE ON THE FLUORESCENCE OF TEETH IN ULTRA-VIOLET RAYS

THAT teeth fluoresce under the excitation of ultra-violet rays has been known for some time. Hans Stubel¹ states that rabbit teeth fluoresce with a somewhat bluish intense white light. In human beings he finds the lens of the eye to be the strongest fluorescing organ, although the teeth are almost equally brilliant.

The following observations were made with a cored carbon arc and a Kromayer lamp, using as filters: (1) Corning purple-violet Ultra, (2) Corex G 986A, (3) Uviol cell with paranitrosodimethylaniline and a quartz cell of copper sulphate.

(1) The dentine fluoresces much more brilliantly than the enamel and seemingly with a bluer light.

(2) The white spot indicative of beginning dental caries does not fluoresce even though unpigmented. A similar effect is obtained by scratching through a paraffin coated tooth and placing in dilute acetic acid over night.

¹ *Arch. Ges. Physiol.*, 142, 1-14, 1911.

(3) Ashed enamel does not fluoresce, nor does dentine which has been boiled in 50 per cent. sodium hydroxide. On decalcifying dentine in dilute nitric acid the organic matrix retains its fluorescent power to an appreciable extent.

(4) Whereas serumal calculus fluoresces little if at all, salivary calculus fluoresces quite markedly with a reddish orange color (some old museum specimens emitted a white light).

These observations are significant in an investigation of the teeth as they may give a clue to the steps in the decalcification of enamel. From No. 3 the conclusion might be drawn that it was the organic matter which fluoresces. We have a means of determining on macroscopic pieces that we have enamel free from dentine. Further work is in progress.

H. C. BENEDICT

CHEMISTRY DEPARTMENT,
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ON THE ANTIQUITY OF RELICS OF MAN AT FREDERICK, OKLAHOMA

IN the issue of SCIENCE for February 10, on pages 161 and 162, is an interesting contribution from Dr. Leslie Spier, of the University of Oklahoma, on the artifacts found recently at Frederick, Oklahoma. The present writer wishes to make some comments on this paper.

The most important statement made by Dr. Spier is that, according to the representations of Mr. Holloman, the owner of the pit, he picked up one arrow head from loose materials at the bottom of the front of the pit as it was being torn down by workmen. On the other hand, Mr. Holloman repeatedly told Director Figgins that he took it out of the hard conglomerate on the floor of the pit. Also the writer has Mr. Holloman's statement to the same effect in two or three letters. In one of these he informs me that he could not free the arrow-head himself, but had to call a workman to bring a tool. A pack knife was brought and with this the utensil was secured. Mr. Holloman further says that Dr. Spier misquotes him in saying that he picked the object from the loose materials. The writer can not for a moment doubt the veracity of either of these gentlemen. There must have been a misunderstanding of some remark made by Mr. Holloman.

In regard to the other flint object, probably a drill, Dr. Spier says that Mr. Holloman scratched it out of the face of the pit with his fingers. Now, if that object had fallen from the surface it would probably have become involved in the red clay which forms the uppermost stratum. In case it had fallen into the sand, this must have been sand which had been

crushed, and it would have required no effort to pick up the little drill. Before the sand is disturbed it is compact enough to stand in a perpendicular face, and to release an instrument protruding from it would require some scratching with one's fingers.

Dr. Spier calls in question the genuineness of the metates. Before he cast this doubt on these utensils he ought to have requested Mr. Figgins to send him one or more of them for examination, and he doubtless would have received them.

Our writer thinks it possible that artifacts may yet be found on the surface of that ridge. I know of no reason why such things should not occur there, and if they are present and if the edge of the pit reaches them they will probably fall down; but this would not prove that those found by Mr. Holloman had fallen down and gotten into the compact sand and cemented conglomerate. And if arrow-heads and metates occur on the surface how is anybody to know whether they are recent productions or those of Aftonian time?

Our writer states certain other possibilities regarding the position of the artifacts. He tells us that we do not know the original position of the surface at this point with respect to the artifacts. He suggests that these lay on the surface of a depression and were subsequently covered by wash. It would be interesting to learn the probable history of a depression of this kind on that ridge. How did it begin, enlarge and finally disappear? It must have been from twenty to twenty-five feet deep in order to let the arrow head down to the conglomerate. There must, too, have been some way of escape for the water which first excavated and later refilled the depression. Mr. Holloman informs me that no ravine now comes within three hundred feet of the spot where the artifacts were discovered. The existing ravines at the foot of the ridge are cutting deeper instead of being refilled. Furthermore, the material filling such a hole or depression must have been mostly red clay; but Mr. Holloman did not observe any interruption of the strata furnishing the sand and gravel called for by his customers. He further says that there are now no depressions on the ridge where water stands after rains and no sink-holes.

Dr. Spier holds that there is an incongruity in the association of artifacts, as identified by our anthropologists, with fossil bones and teeth of animals of Aftonian age. There is an incongruity, but this is the creation of the anthropologists. They measure most things pertaining to human history in America by European standards. Because stone implements appear only late in Europe and are crude it is concluded that the art of working stone must have had a similar development in America. The writer believes

that during the first interglacial stage men came from Asia and brought with them the art of skillfully chipping flint. Evidence of this has recently been furnished at Colorado, Texas; possibly, too, at Folsom, New Mexico.

Our anthropologists are forced to admit that the age of human bones and artifacts is to be determined by geology, but they insist on making their own geology. When the geology appears to be opposed to their view a variety of agencies are invoked to account for the apparent occurrences of Pleistocene man under the circumstances. It is rare that it can be established that the agency postulated has actually done the work. A long catalogue of these possible means might be compiled. The latest addition is the action of whirlwinds. This might well be called upon to explain the case at Frederick. What is more probable than that, while men slept, a mighty wind arose and, gathering up a cache of Comanchean implements of the wigwam and the chase, hurled them with violence against the face of that quarry and drove them into the hard sand and the conglomerate?

The writer has always admired the work done by Dr. Spier on the pebbles and artifacts systematically collected at Trenton, New Jersey. It had been declared that the deposit, a few feet thick only, had been so thoroughly disturbed by burrowing mammals, by the uprooting of trees, by the driving of palisades, and in other ways, that no conclusion could be reached as to the age of the artifacts embedded in it. Dr. Spier's work demonstrated that the pebbles and the artifacts had a definite arrangement in the stratum. There is general agreement that the deposit was laid down by Delaware River when the Wisconsin glacier had its front standing about sixty miles above Trenton. Dr. Spier's paper furnishes evidence hardly controvertible that the makers of the artifacts were in that region at the culmination of the Wisconsin glacial stage. The reader will enjoy a perusal of Dr. Clark Wissler's comments on the value of Dr. Spier's work.¹

As is usual, our anthropological friends, on the announcement of the new discoveries of supposed Pleistocene man, sound the warning that we must proceed with caution. Do they exercise superior caution themselves? Was the anthropologist acting with due caution when he asserted, without the necessary investigation, that the deposit at Trenton had been thoroughly disturbed? Did another anthropologist display a cautious spirit when he insisted that masses of muck, sand and marl thrown back into a grave would soon rearrange themselves into their original relations and when he asserted he found muck, sand and marl undergoing restratification which had been

¹ *Scientific Monthly*, Vol. II, p. 234.

thrown on the dump by the dredge? Was even my friend Dr. Spier proceeding cautiously when he suggested a depression where the Frederick artifacts were discovered, apparently without inquiring of the owner of the pit and of the workmen whether they had observed anything of the kind?

Because certain existing tribes do not use metates Dr. Spier thinks it improbable that they were employed by people of early Pleistocene time. However, we do not yet know much about the climate of that period nor much about the resources and arts of the people.

OLIVER P. HAY

WASHINGTON, D. C.

ONE HUNDRED PER CENT. HATCH

ON October 31, 1927, the writer artificially impregnated 230 eggs taken from a small two-year-old hatchery reared brook trout, *Salvelinus fontinalis*. Two males were used to effect fertilization. Instead of following the accepted method of washing the eggs soon after insemination, the eggs were allowed to harden in the milt. After sixty-one days of incubation, 230 normal fry emerged tail first with elongated yolk-sacs which is an index of perfect fertilization.

In state, commercial and private hatcheries, the writer has met with wonderful success by holding the eggs in milt during the agglutination period.

These results indicate that the concentration of sperm suspensions may have a direct influence on the micropyle of the egg, which activates complete fertilization when agglutination takes place in the milt.

RALPH C. JACKSON

U. S. FISHERIES STATION,
NASHUA, N. H.

MORE DATA

IN spite of all the discussion on the subject that has been going on in SCIENCE, here is Mr. Sainton, of Cornell, saying (in the last number of the *Journal of The Optical Society of America*) "data is." It is known that Cornell is a special sinner in this respect.

As regards the two wrong pronunciations of *data* (lately discussed in SCIENCE), *dāta*, it may be pointed out, is far worse than *däta*, for the reason that those who adopt the thoroughgoing modern pronunciation of their Latin and Greek may feel obliged to apply it to *datum* too.

It is remarkable what a high literary standard the medical people have preserved in their scientific language. But they are wrong in sometimes saying "photo-sensitive." One can say "photo-esthetic" or "light-sensitive," but "photo-sensory" (or photo-sensitive) is a sad hybrid.

CHRISTINE LADD-FRANKLIN

COLUMBIA UNIVERSITY

SCIENTIFIC BOOKS

Romance of the Sun. By MARY PROCTOR, xii + 266 pages. Harper and Brothers, London and New York, 1927. \$2.50.

MISS MARY PROCTOR's book, "Romance of the Sun," contains many interesting pages for those who have little or no knowledge of astronomy, and who wish information about that part of this science which deals with the nearest star, our own sun. The book is written in popular language so that it can be read easily by any one. The sun is so important, not only to astronomers for their investigations, but also to every person and to everything living on this earth, that it is well to have books on this subject written for all types of readers.

After a brief description of the appearance of the sun's surface, four chapters are devoted to the problem of finding the distance from the earth to the sun. Accounts are given of the attempts made to find this distance accurately by observing the various transits of Venus across the sun's disc which occurred between 1629 and 1882. Horrocks' observation of the transit of Venus in 1639 is well described, and made more vivid by quotations from the writings of that exceptional young minister who was such an enthusiastic astronomical observer. The chapter on Sir David Gill's observations of Mars in connection with this same problem is likewise made more interesting by several extracts from Lady Gill's book, "Six Months in Ascension." Just at the end of this chapter, on page 70, there is an important misprint. The sun's mass is given as 32,000 times that of the earth instead of 332,000 times the earth's mass.

The fifth and sixth chapters deal with the constitution of the sun and its atmosphere, the analysis of its light and the subject of solar energy, especially the fraction of that energy received by the earth. Several times in the descriptions of phenomena on the sun, phrases are used which might give to readers without astronomical knowledge the impression that the sun was at least in part liquid. The words "Vast oceans of molten metal," on page 71, form such a phrase which can hardly be considered appropriate when applied to a body like the sun, which is known to be purely gaseous.

Even in a popular book of this length, it would seem that a fuller treatment of the source of the sun's heat would have been of interest to any reader. No reference is made to the latest theory, now generally accepted by astronomers, that the sun's energy is due to the radiation of its mass. A more detailed description of the sun's surface would have increased the value of the book for the majority of readers. The subject of sun-spots is rather neglected. A brief and superficial description of sun-spots is given in

the introduction. Nothing is said of the periodicity of these spots, or of the relation of the sun-spot curve to terrestrial phenomena and to the shape of the solar corona. Although hydrogen and calcium flocculi are referred to and also shown in two illustrations, no explanation of these terms is given.

Similarly there is a lack of explanation in the case of some of the instruments used in the study of the sun; especially in the case of the spectroheliograph and the spectrophelioscope, which are not so well known as the spectroscope. Brief descriptions of the main features of these instruments might have been given which would not have been at all technical but would have made much clearer the sections and quotations about observations with these instruments.

The remaining four chapters discuss the corona and its observation, and give descriptions of various eclipse experiences. It hardly seems worth while to give up twenty-five pages of one of these chapters to the unsuccessful attempts to photograph the corona without an eclipse, when in view of our present knowledge the reason for these failures is so obviously due to the feebleness of the light from the corona compared with the brilliant light of the sun itself.

In the description of the cause of a solar eclipse, no definition of a partial eclipse is given, though mention is made of a partial eclipse of the sun on January 24, 1925, in London. Those of us who remember this as the total eclipse seen under such

favorable conditions by so many people in New York and Connecticut may be pardoned if we are a little disappointed to find no other reference in this book to this particular eclipse.

The quotations from the personal eclipse experiences of the writer and other observers can not fail to interest all readers, and to make those who have not seen a total eclipse eager to have that opportunity. After all, no description can do justice to the thrill of actually seeing this wonderful phenomenon. The description in the last chapter of the eclipse of June 29, 1927, visible in England and Norway, gives an excellent picture of the numerous activities connected with the observation of a total eclipse at the present time. The attempts to observe the eclipse from airplanes were only partially successful because of clouds, but gave to those who were in the airplanes experiences that would always be remembered.

IDA BARNEY

YALE UNIVERSITY OBSERVATORY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

MOUNTING CHICK EMBRYOS

IN elementary courses in embryology sagittal sections often present considerable difficulty to the student. One reason for this is the practical impossibility of getting a truly sagittal section extending the

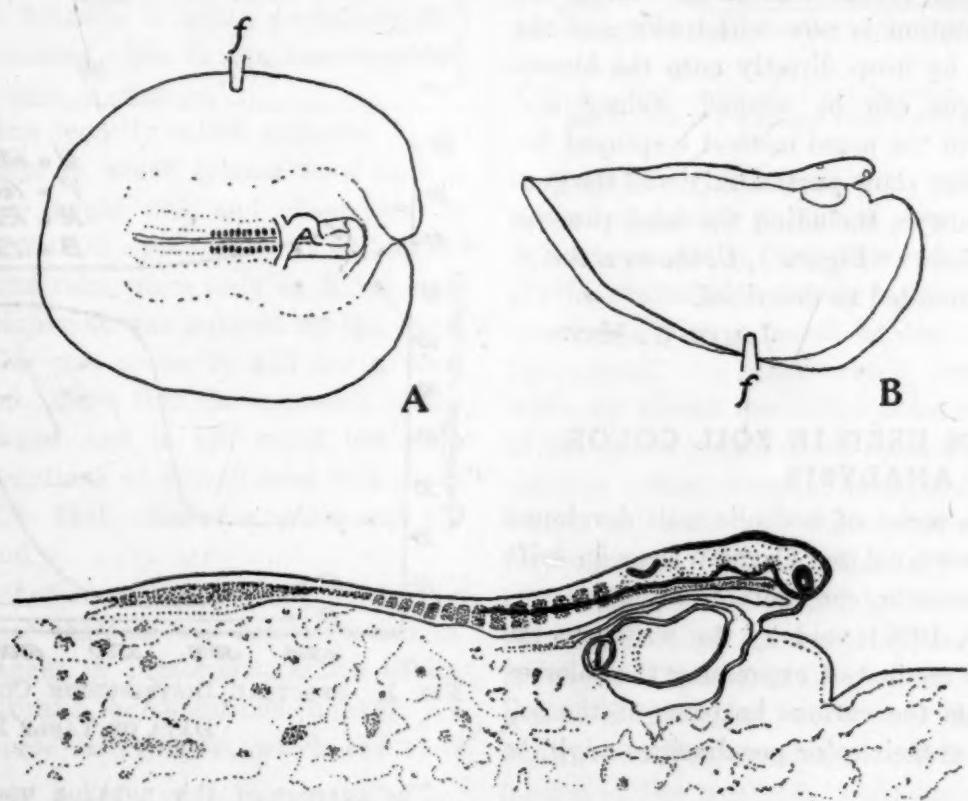


FIG. 1. Mounting chick embryos. A. Position of blastoderm in watch glass ventral side up, *f*, point at which forceps grasp edge of blastoderm. B. Folded blastoderm with right side folded over left side so that embryo lies along crease. C. Side view of embryo mounted as described.

whole length of the embryo; another is due to the fact that sagittal sections lack many of the structures which the student has come to regard as landmarks in his study of transverse sections. On the other hand, the preparation of sagittal sections presents difficulties for the technician.

The present writer has used for some years in his classes preparations which show the eight to fourteen somite (thirty to thirty-six hours incubation) chick in side view, in place of sagittal sections. Such preparations are scarcely more difficult to make than the usual whole mounts and help greatly the student in his attempt to visualize the structure of the embryo of this stage. The method has up to the present been used only on embryos before the beginning of torsion in the head region. It is possible, however, that it might be modified to apply to embryos of somewhat later stages.

The egg is opened in salt solution and the blastoderm cut from the yolk and floated into a watch glass in the usual way. It must then be turned over while still alive so that its dorsal surface is underneath (Figure 1, A). The lateral edge of the blastoderm directly opposite the middle of the embryo is then lifted with forceps and folded over so that the embryo appears along the folded edge and projects from it (Figure 1, B), while the half of the blastoderm which was lifted now lies over the other half which remained in position in the watch glass. The operation of folding the blastoderm can best be carried out under a binocular microscope. It is important to make the fold such that the entire length of the embryo lies along the crease. The salt solution is now withdrawn and the fixative added drop by drop directly onto the blastoderm. Such embryos can be washed, stained and mounted according to the usual method employed for "whole mounts." They show particularly well the general form of the embryo, including the head process, the foregut and the heart. Figure 1, C, shows a sketch of a chick embryo mounted as described.

JAMES W. MAVOR

UNION COLLEGE

COLOR DISCS USED IN SOIL COLOR ANALYSIS

In the study of a series of podsolic soils developed upon the reddish-brown colored Early Wisconsin drift of east central Minnesota, considerable attention was recently (February, 1927) paid by the writer to the question of the best method of expressing the color of samples of soil from the various horizons of the soil profiles, in order that their color peculiarities might be brought out.

Munsell Rotating Color Discs were used, as one means amongst others, of analyzing and expressing

the color of the disturbed soil samples. These discs are essentially Maxwell's discs, of stiff paper, colored "Red," "Yellow," "White" and Black." They are made to rotate upon a motor-driven shaft, and provide a means of matching a very great number of colors simply by altering the relative proportions of the different color discs exposed to the eye. Each one of the four almost new color discs was examined with a Keuffel and Esser Spectrophotometer, with the results given in Table I. Their spectral distribution curves are plotted in Figure 1. Each value for relative brightness represents the mean of five closely agreeing photometer readings. The standard white used in the machine was a freshly scraped surface of a block of magnesium carbonate.

TABLE I. ANALYSIS OF COLOR DISCS USED IN SOIL COLOR ANALYSIS

Wave length	Relative brightness expressed as percentage			
	"Red" Disc	"Yellow" Disc	"White" Disc	"Black" Disc
7000 Å	Per cent.	Per cent.	Per cent.	Per cent.
6500	60.2	70.8	75.6	3.4
6000	55.6	66.2	73.8	2.5
5500	22.5	66.8	74.0	2.3
5000	5.8	63.0	74.0	2.3
4500	6.0	22.0	76.2	2.2
	10.2	22.2	80.5	3.0
$\frac{I_{6500}}{I_{5000}}$	9.27	3.01	—	—
$\frac{I_{6500}}{I_{4500}}$	2.47	.99	—	—

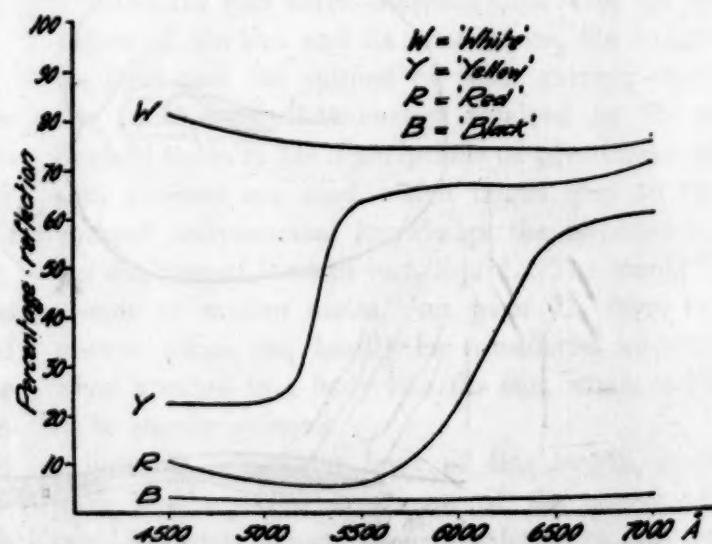


FIG. 1. SPECTRAL DISTRIBUTION CURVES PLOTTED FROM DATA OF TABLE I.

The purpose of this notation upon the subject is to point out the relative impurity of the color discs. This lack of purity of hue means that the percentages assigned

to the various colors used on the disc are far from representing percentages of pure spectral hues. The actual percentage transmission of spectral red, for example, from the "Red" disc is lower than that from the "Yellow" disc. To the eye, of course, the differences in reflection of light of these wave lengths appears extreme in the opposite direction. By means of the ratio $\frac{I_{4500}}{I_{5000}}$ the different appearances to the eye of these two discs is more satisfactorily represented. Similarly the ratio "Red" as determined by color disc analysis is found to bring out better the apparent striking color differences of two soils.

G. B. BODMAN

DIVISION OF SOILS,
UNIVERSITY OF MINNESOTA

SPECIAL ARTICLES

LIVING CELLS TWO AND A HALF CENTURIES OLD

RESEARCHES dealing with the growth and hydrostatics of trees and other massive plants have led to a consideration of the activities of living cells in the interior of large stems. Rigidity and other mechanical features of tree-trunks are such that living cells in layers a year old can not grow or divide and hence the existence of a living cell in layers 50 or 100 years old may be taken as an example of a protoplast which has carried on an individual existence for that length of time. In many trees all living cells perish when the splint or sap wood of which they form a part is converted into heartwood. A notable case was recently described in SCIENCE in which medullary cells of the redwood remained alive in the heartwood attaining an age of over a century.¹

Professor Faul has recently called attention to the work of J. H. White in which tyloses were seen in heartwood of beech, maple, oak and other trees in regions invaded by *Fomes applanatus*. It is implied that these formations take place only in living cells and that their development was induced by the penetrating fungus. The case seems to call for a more detailed examination. Now that the existence of living cells in heartwood and in old wood has been rescued from the negations of widely used text-books it is highly probable that numerous additional examples will be found.²

Our quest for other examples of long-lived cells has had for its chief purpose the determination of the progressive changes in protoplasts which attain great age and to appraise the conditions endured. A desert tree *Parkinsonia microphylla*, which has been

used for tests in conduction and growth has yielded results of interest in this matter.

This bean tree is a prominent member of the desert flora of the southwest and because of its smooth green bark is known as "Palo verde." Despite the fact that its growth in thickness is at an extremely low rate, 0.2 to 0.6 mm annually, the trunk is soft and brittle, losing 45 per cent. of its dry weight in two days in the drying oven at 100° C. Bark and wood are heavily loaded with crystals, mostly calcium carbonate. The ash constitutes as much as 3.4 per cent. of the dry weight.

Sections of stems 10 cm in diameter and over 75 years old, first examined, showed occasional living ray-cells near the center and also a number of tracheids in which the nucleus and cytoplasm were plainly in a normal and active condition.

An older excentric trunk which stood in a leaning position showed sound moist wood in the flank which was 9 cm in thickness. Several counts of layers by Dr. Forrest Shreve gave a basis for the estimate that the age of the trunk might be safely taken as between 275 to 300 years old. Living ray cells and tracheids could be seen in sections near the center without staining and with a dry objective. We have no hesitancy

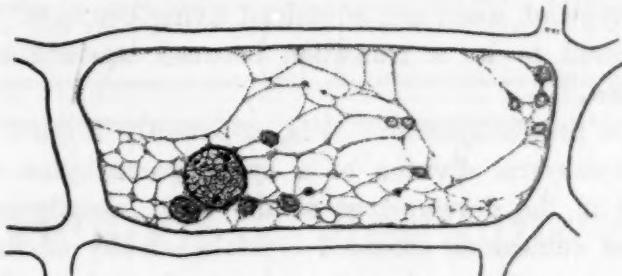


FIG. 1. Ray cell of *Parkinsonia* over 250 years old. Reticulum of nucleus and cytoplasm well defined.

in announcing that these elements may be safely considered as having an age of over 250 years.

Macroscopically the stele of *Parkinsonia microphylla* presented a nearly uniform light straw color sometimes with a small central core of heartwood (duramen). In other words, sapwood (alburnum) made up almost the entire mass of wood. Elements of the xylem consisted of tracheids typical in shape; coarsely pitted vessels; elongated thick-walled cells with blunt ends, and short prosenchymatous cells in vertical rows near the medullary rays.

The tracheids composed by far the greatest part of the xylem. They measured approximately 20 microns in length. Those laid down at the end of the growing season in the oldest wood near the central pith had walls averaging 4 microns when measured between lumina of two tracheids, while those formed in spring and summer and measured in the same way averaged 3 microns in thickness. Comparative measurements of tracheids in xylem formed in recent years was 3.2

¹ MacDougal, D. T., and G. M. Smith, SCIENCE 66, 456-457. 1927.

² Faul, J. H. "Living Cells in Heartwood," SCIENCE 67, 296. 1928.



FIG. 2. Tracheid of *Parkinsonia* over 250 years old. Nucleus plump and normal.

microns for those laid down in the fall and 4.2 microns for those formed in spring and summer.

Living tracheids are numerous, even in the oldest part of the stem. Part of an annual ring in one bundle consisting of 120 tracheids showed nuclei and more or less cytoplasm in approximately 50 per cent. of the tracheids. Likewise many of the medullary ray cells were living. Nuclei in both tracheids and ray cells were large, well-rounded and clearly showed a reticulum. One to three nucleoli were present.

The vessels or tracheae were coarsely pitted and few in number. Some of them contained a substance which stained brown with Haidenhain's iron-alum haematoxylin. Otherwise they were not unlike those found in woody dicotyledonous plants.

Elongated cells with coarsely pitted end walls and abundant pits in lateral (radial) walls were found near the rays but extended vertically. Frequently this type of wood cell contained living contents. It appeared to be a transition between tracheid and trachea.

The prosenchymatous cells, apparently formed by the transverse division of a xylem parenchyma cell early in the development of the wood, usually contained cubical or six-sided crystals. Many of these cells were alive and contained cytoplasm in contact with crystals in various stages of development.

In previous discussions attention was called to the fact that cells attaining great age were of the thin-walled parenchymatous type. Later Dr. F. H. Long prepared a manuscript now ready for publication in which epidermal cells, including stomata of the tree-cactus of Arizona, are shown to attain an age of over a century.

The preceding paragraphs record the existence of ray cells of the thin-walled type in *Parkinsonia* and also of typical tracheids with heavy walls in parts of trunks formed over two and a half centuries ago. No observations have been made as to the length of the period of enlargement of these elements, but as the season's growth of this desert tree is completed within the brief period of the summer rains it may safely be taken to be something less than a week. Existence is continuous for 12 or 13 thousand weeks, thus setting a new high ratio between the developmental period and the period of mature existence.

Heartwood is not always formed in *Parkinsonia*, the vessels are large and the protoplasmic strands con-

nnecting neighboring cells are well defined and numerous. By this arrangement the innermost cells are much more closely connected with the surface layers of the trunk than in the redwood or the central parts of other trunks.

The cells capable of attaining great age appear to lose their embryonic character very early. At the same time surfaces of wounds of this tree dry out so quickly that rarely is any notable callus formation found. The living cells of the trunk endure a range of temperature higher than those to which trunks of mesophytic trees are subject. The actual range, however, may be not nearly so great as those attained by cells in flattened stems in cacti in which mid-day temperatures of over 50° C. are common.

The gases in the vessels and intercellular spaces of trunks of *Parkinsonia* are extractable at about the same rate as in *Quercus*. Samples taken from bores extending 10 to 12 cm or to the center of trunks at 0.3 to 0.4 atm showed never less than 1 per cent. carbon dioxide and the proportions in some cases were as high as 16 per cent.

The above notes are intended as an announcement of the discovery of living cells older than those noted in any record in which estimates of age have been included. Elements of *Parkinsonia*, including ray cells and tracheids, have been found near the center of a trunk nearly three centuries old. The appearance of the nuclei and cytoplasm is not widely away from that of young cells and it may be safely predicted that the examination of older trees would reveal living elements of even greater age.

The long-lived cells endure a wide range of temperatures and the gases in the vessels which are dissolved in their sap are very high in carbon dioxide. Mineral elements of which calcium is the chief component accumulate in the wood so that the ash constitutes 3.4 per cent. of the dry weight. The ash of beech wood forms but 0.355 per cent. of its dry weight. The caenocytic arrangement of the living cells is so marked as to suggest that the connections afforded by the heavy connecting protoplasmic threads may be important as conductive organs maintained between the deeply lying old protoplasts and the surface layers.

D. T. MACDOUGAL,
J. G. BROWN

LABORATORY FOR PLANT PHYSIOLOGY,
CARNEGIE INSTITUTION OF WASHINGTON
AND UNIVERSITY OF ARIZONA

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SCIENCE NEWS

Science Service, Washington, D. C.

THE EFFECT OF SUPER-SONIC WAVES ON BLOOD CORPUSCLES

SUPER-SONIC waves which are sound-waves vibrating too rapidly to be heard, have now been brought under such control that observers can watch their effects through a high-power microscope. Using a small electrically driven crystal to produce these waves at a rate of 406,000 a second, Professor E. Newton Harvey, of Princeton University, and Alfred L. Loomis, of Tuxedo Park, N. Y., have watched blood corpuscles warp, twist and disintegrate, and have seen the living protoplasm in plant cells whirl in a dance of death, faster and faster until it has separated into spinning bits, broken and disorganized.

The apparatus used in these experiments is a refinement, on almost a jeweler's scale, of an earlier form devised by Mr. Loomis and Professor R. W. Wood, of the Johns Hopkins University. It takes advantage of the fact that when a rapidly alternating electric current is fed into a quartz crystal cut in a certain fashion, the crystal vibrates at the speed of the electrical oscillations, producing sound-waves. By cutting the crystal small, and using an electrical oscillator of the type employed in radio stations, it is possible to produce sound waves twenty times as fast as the 20,000-per-second waves which represent the upper limit of human hearing ability. And these extremely rapid waves, at high enough intensities, have a tearing, killing effect on living substance. They have been nicknamed "the death whisper."

"Observing under a high-power microscope," Professor Harvey and Mr. Loomis state, "it has been possible to follow the progressive destruction of frog blood corpuscles. The oval cells at first become warped and twisted. Strained areas appear and the color fades, leaving a pale distorted shadow. Human blood corpuscles are likewise twisted and sometimes broken up into many small globules like an emulsion of oil."

Vibrations on the leaves of a water-plant, in which the living protoplasm usually keeps up a constant circulation around the wall of each cell were also investigated. "High frequency waves of low intensity passed through these cells caused the protoplasm to rotate very much as in the normal rotation. Increasing the super-sonic intensity increases the movement until the whole cell is a rapidly whirling mass of protoplasm, fragments of which are torn loose and rotate as small balls in the vacuole. The effect is very striking.

"The microscopic method offers a promising means of attack upon the problem of influencing the development of eggs of various species, as forces can thus be applied inside an egg at different stages of its development without the necessity of puncturing the cell wall or enveloping membrane. The results immediately suggest the interesting possibility of converting an egg with determinate cleavage into an indeterminate one by thoroughly mixing and redistributing the organ-forming sub-

stances of its interior. We are now engaged upon this and allied problems, the results of which we expect to publish in due course."

TESTS OF HEARING

HOLDING a watch near the ear to test hearing may soon be a thing of the past. Ear tests developed by scientists of the Bell Telephone Laboratories, New York, make use of accurate instruments which, with psychological aids, determine a person's exact degree of hearing. False claims of either deafness or exceptional hearing are of no avail, for the truth can now be easily discovered.

A push-button on the instrument which measures the tone emitted for the test permits the interruption of the sound at any moment. If a patient says he hears a tone, and then claims that he still hears it when it has been cut off, it is evident that he has been deceiving himself.

Another device makes it possible to switch the sound to either ear or both. A loud tone in either ear causes the eye nearer it to blink slightly, though the patient may claim that he hears nothing.

The patient is made to read aloud in his normal voice in another test, while a tone is switched from ear to ear. The intensity of the voice is regulated by the sound of the voice and this can be drowned out. One who has normal hearing in both ears will, however, be able to hear his voice with one ear while the tone is switched to the other, and he will not change the level of his voice as the tone is switched back and forth. If he is deaf in one ear, he will raise his voice every time the tone sounds in his normal ear.

When the tone is switched on and off both ears, a person with normal hearing will raise his voice each time the tone is turned on, while one who is deaf will continue to read without changing his voice.

To detect a false claim of deafness in one ear, the tone is switched repeatedly back and forth between the ears at varying intensity, and the patient is asked to signal each time he hears a sound. A truthful signal can be made almost instantaneously, but if the patient must stop to decide each time in which ear he hears the sound, much more time is required and he quickly becomes confused, thus betraying himself. These tests are expected to prove valuable in compensation cases where loss of hearing is involved.

PROBABLE FLOODING OF THE WHITE AND BLACK RIVERS

THE low-lying areas along the White and Black Rivers in Arkansas and Missouri are in danger of another flood. Heavy rains which fell in that region on April 20 will so swell the waters of these rivers that rises of one to six feet above flood stages were expected, beginning on April 21 in the upper portion and extending to the lower parts of the White River the first few days of May. These predictions are made by Dr. H. C. Frankenfield, in charge

Marine Biological Laboratory Woods Hole, Mass.

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Write for Bulletin 273

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THE MONIST

A Quarterly Magazine

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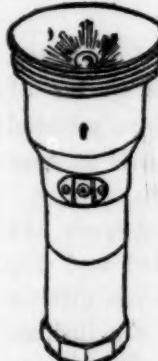
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ANTHONY FIALA

25 Warren Street

N. Y. City

of the rivers and flood division of the U. S. Weather Bureau.

These areas suffered severely in the great Mississippi Valley flood of last year and the farmers have not yet fully recovered. Moreover, high water caused them damage and concern about two weeks ago. News of hardship and privation are therefore to be expected from this region in the next few weeks.

The Mississippi River will feel the influence of these floods in its tributaries, but on the whole this great river is behaving itself this year.

There are no large cities along the White and Black Rivers, but towns which were expected to feel the flood include: Batesville, New Port, Georgetown, DeValls Bluff, Clarendon, all in Arkansas and on the White River, and Poplar Bluff, Missouri, on the Black River.

Heavy rains in the lower basin of the Ohio River, some of them having sent to earth as much as three inches of rain in the last twenty-four hours, will cause a considerable rise in that river. It is, however, expected that the excess water will flow down to the Mississippi without great trouble.

A REMEDY FOR SEASICKNESS

SEASICKNESS may cease to be the voyager's bugbear if experiments of Drs. J. Frank Pearcey and Daniel Hayden, of Chicago, are substantiated by further tests.

The possibilities of the new remedy came to light when the doctors were making experiments to determine the depressant effects of the common drug, sodium nitrite, on the mechanism of the middle ear that controls the balancing of the human body. The experiments were reported to the American Medical Association.

"Believing that seasickness is due mostly, if not completely," the authors explained, "to overstimulation of the vestibule (of the middle ear), we felt that the nitrites offered a direct attack at the long-sought but never attained cure for the terrible malady of the ocean voyage."

So when Dr. Hayden was about to take a trip abroad he sought to put his theory to the test, but none of the passengers on the trip going over the Atlantic accommodated him by becoming ill. On the return voyage, however, he had better luck. Sixteen succumbed and were divided into two groups of eight each, one of which received the nitrite treatment while the others were kept under observation as controls. Every attempt was made to have patients with equally acute symptoms in each group.

The controls were prostrated for about two days, but the others who received from three to five grains of sodium nitrite every two hours until they were relieved were comfortable on deck and able to eat meals in four hours. There was no recurrence of symptoms.

Although the work has a sound experimental basis, the actual tests having been adequately controlled and 100 per cent. cures obtained, the authors expect to use nitrites in a much greater series before drawing final conclusions. They are certain, however, that they will cure many cases of seasickness, but it is also possible that there are cases that will not be cured.

ITEMS

THE U. S. Bureau of the Census is waging a campaign to bring every state in the Union into the birth and death registration area before 1930. The registration area is slowly growing, with some expansion in 1927, but federal health officials feel that it is extremely important for the country's warfare against disease that accurate information concerning the birth and death records of the entire nation be available to epidemiologists and health workers. The birth registration area at present covers 40 states and the District of Columbia, which takes in 87.3 per cent. of the total population of the country. In the death registration area are 40 states, the District of Columbia and 21 cities in non-registration states of the death registration area. This gives information on the cause of death of 91.3 per cent. of the population of the United States.

NORTH sky light, long accepted as the perfect standard of white light for examining colors, has been found to vary in intensity and color, not only from day to day, but also from hour to hour. The American Institute of Electrical Engineers reports that north sky light is not white, but blue and the examination of colors under such light exaggerates blues and minimizes reds and yellows. It is claimed that noon sunlight and not north sky light should be accepted as the standard, and that artificial white light for color discrimination purposes should approximate noon sunlight.

VICTIMS of Addison's disease and other conditions associated with adrenal insufficiency may be greatly benefited by a method of treatment now under development by Drs. J. M. Rogoff and G. N. Stewart, of Western Reserve University, according to an announcement made at the meeting of the Federation of American Societies for Experimental Biology at Ann Arbor. By means of injections of extracts made from adrenal glands obtained from the slaughter house, Dr. Rogoff has enabled dogs completely lacking the adrenal glands to survive for periods from 18 to 78 days. This extract when sufficiently purified can be used to treat Addison's disease, a condition in which the function of the adrenals is greatly impaired. Progressive anemia develops in this disease, which usually results in death. The functions of the adrenal gland are obscure at the present time and the work by Drs. Rogoff and Stewart will probably lead to new developments in the treatment of other serious ailments associated with adrenal insufficiency.

FAR under the feet of pedestrians who are serenely unaware of what is happening, two parallel subway tunnels are being blasted and bored through the bed rock of Manhattan. At the rate of twelve feet per day, the tunnels are pushing their way, ninety feet below Fifty-third street. At the East River they will meet tunnels dug under the East River from Long Island. The rock taken out of the tunnels in Manhattan is being used to fill in deep spots in the river where the tunnels pass. The same rock will thus be dug out for a second time before being finally disposed of. The use of electrical machinery in this remarkable operation is eliminating almost all manual labor in tunneling.